Astronomy: Earth and Space Systems

8-4 The student will demonstrate an understanding of the characteristics, structure, and predictable motions of celestial bodies. (Earth Science)

8-4.7 Explain the effects of gravity on tides and planetary orbits.
Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: Tides as an effect of the Moon was illustrated in 4th grade (4-3.6), but being an effect of the pull of gravity is new conceptual material. Gravity effecting planetary orbits is a new concept in this grade. High school Earth Science students will study further the effect of gravity on the formation and shapes of galaxies (ES-2.8).

It is essential for students to know that tides and planetary orbits are caused by the pull of gravity.

Effects of Gravity on Tides

- The Moon being closer to Earth than the Sun (distance) has the greatest pulling effect on *tides*, the rise and fall of ocean water in this case.
- The Sun also pulls on Earth and
  - can combine its force with the Moon causing even higher tides, *spring tides*
  - or can be a right angles, pulling against the Moon's pull, causing very little tidal change, *neap tides*.

Effects of Gravity on Planetary Orbits

- The Sun's gravitational attraction, along with the planet's inertia (continual forward motion), keeps the planets moving in *elliptical orbits* (Earth's orbit is slightly oval) and determines how fast they orbit.
- Planets nearer the Sun move/orbit faster than planets farther from the Sun because the gravitational attraction is greater.
- When a planet is farther from the Sun, the gravitational attraction between them decreases and the planet moves/orbits slower.

It is not essential for students to know how gravitational force causes the high tides on both sides of Earth, or how to produce an elliptical orbit using two foci.

Assessment Guidelines:
The objective of this indicator is to *explain* the effects of gravity's pull on tides and planetary orbits; therefore, the primary focus of assessment should be to construct a cause-and-effect model that varies the effect of the pull of gravity in different ways. However, appropriate assessments should also require students to *interpret* diagrams that show varying aspects of tidal pull or planetary orbits; *infer* how a change in the force of gravity would change other factors; or *recognize* the factors that keep planets in orbit around the Sun.